

APPLICATION FORM FOR A NEW APPLICATION		Docket No.	H09-033
Engineering Control Room	Person in Charge	Date	Dec. 5, 1997
Dec. 15, 1997 Mizoguchi approved.	Dec. 12, 1997 Maki approved.	Approved by	Reviewed by
		Dec. 10, 1997 Muraki	Dec. 8, 1997 Muraki
		Drafted by	Dec. 5, 1997 Suzuki
Title of Invention (provisional)		Machining Navigation	(Extension: 3436)
Inventor Name	Division to which the Inventor Belongs	Machining Technology Research Center (Extension: 3436)	
Model Number		(Please also write the name in the assignment.)	
Expected Disclosure Date in Catalogue or as a Product	Kerui SUZUKI (Mounting NM64)	Name of Unit	NC
1. Objective	February 1, 1998		
To reduce machining time.			
2. Prior Art Having the Same Objective or Using a Similar Method		Attachment#	
Mazatrol Program (NC Control) allows cutting conditions such as cutting speed and feed rate to be automatically calculated.			
3. Problems in Prior Art to be Solved			
Appropriate cutting conditions for given machines and tools in high speed cutting are not provided.			
4. Embodiment of Invention: Configuration or Method of the Present Invention		[Attachment] ⇒ Display Algorithm	
<p>1) During operation, automatically determined values of cutting conditions are displayed in accordance with the specification of the apparatus (in a graph showing the relationship between the spindle rotating speed and the spindle output). At the same time, specific figures that indicate, for example, how many meters per minute the cutting speed can be increased, are displayed.</p> <p>2) High-speed machining examples (of MAZAK apparatus's performance) are displayed. Tools (type &amp; manufacturer) and cutting conditions (cutting speed &amp; feed rate) are displayed.</p>			
5. Effect of Invention			
By displaying high-speed and highly efficient cutting conditions, the invention permits an operator to attempt and achieve reduction in machining time of a variety of apparatuses including an apparatus for normal cutting and an apparatus for high-speed cutting, while making use of the characteristics of the Mazatrol Program (NC control).			
6. Special Note			

Assignment		Date: December 5, 1997	
Assignee		[Address] 1, Aza-Norifune, Ohaza-Oguchi Ohguchi-cho, Niwa-gun, Aichi-ken [Name] YAMAZAKI MAZAK KABUSHIKI KAISHA [Representative] Teruyuki YAMAZAKI (President)	
※ We hereby declare that we assign the entire right, title, and interest in the invention described in Application Form for a New Application..			
Assignor		[Address] 366-1, Mizuse Yono, Ohguchi-cho, Niwa-gun, Aichi-ken [Name] Kenji SUZUKI (Seal)	
		[Address] 89, Minamiyama, Hiroji-cho, Showa-ku, Nagoya-shi, Aichi-ken [Name] Toshiyuki MURAKI (Seal)	
		[Address] 72-2, Nakayashiki, Takao, Fuso-cho Niwa-gun, Aichi-ken [Name] Makoto TANAHASHI (Seal)	
		[Address] 5-61-2, Jinai-cho, Ogaki-shi, Gifu-ken [Name] Hirokazu YOSHIDA (Seal)	
(When there are additional inventors, please attach another sheet.)			
※ Prior Art (including the related applications/patents owned by YAMAZAKI MAZAK)			
Having reviewed this invention, we decided that we would ( <input checked="" type="radio"/> file / <input type="radio"/> not file ) a new application.			
On October 23, we discussed this invention with Mr. Aida, who is the patent attorney in charge.			
Representative	AIDA PATENT ATTORNEY'S OFFICE	Category	A
Docket No.	H09-033		

October 8, 1997

YAMAZAKI MAZAK KABUSHIKI KAISHA  
Machining Technology Research Center

## Indication of Navigation Information: Consideration of Algorithm

<Drilling Machining> Tool diameter  $\geq \phi 3$ 

Spindle Load $\leq SF$ ?	Cutting Speed $\leq WJ$ ?	Spindle Rotating Speed $\leq CH$ ?	Processing
No	No	-	-
No	Yes	-	
Yes	No	-	Navigation Information Number 2 is displayed. (Change cutting tool material.)
Yes	Yes	-	Navigation Information Number 1 is displayed. (Increase cutting speed.)

## &lt;End Mil (Roughing) Machining&gt;

Spindle Load $\leq SF$ ?	Cutting Speed $\leq WJ$ ?	Spindle Rotating Speed $\leq CH$ ?	Processing
No	No	No	-
No	No	Yes	Navigation Information Number 4 is displayed. (Change cutting tool material.)
No	Yes	No	
No	Yes	Yes	Navigation Information Number 3 is displayed. (Increase cutting speed.)
Yes	No	No	Navigation Information Number 4 is displayed. (Change cutting tool material.)
Yes	No	Yes	Navigation Information Number 4 is displayed. (Change cutting tool material.)
Yes	Yes	No	Navigation Information Number 3 is displayed. (Increase cutting speed.)
Yes	Yes	Yes	Navigation Information Number 3 is displayed. (Increase cutting speed.)

## &lt;Face Mil (Roughing) Machining&gt;

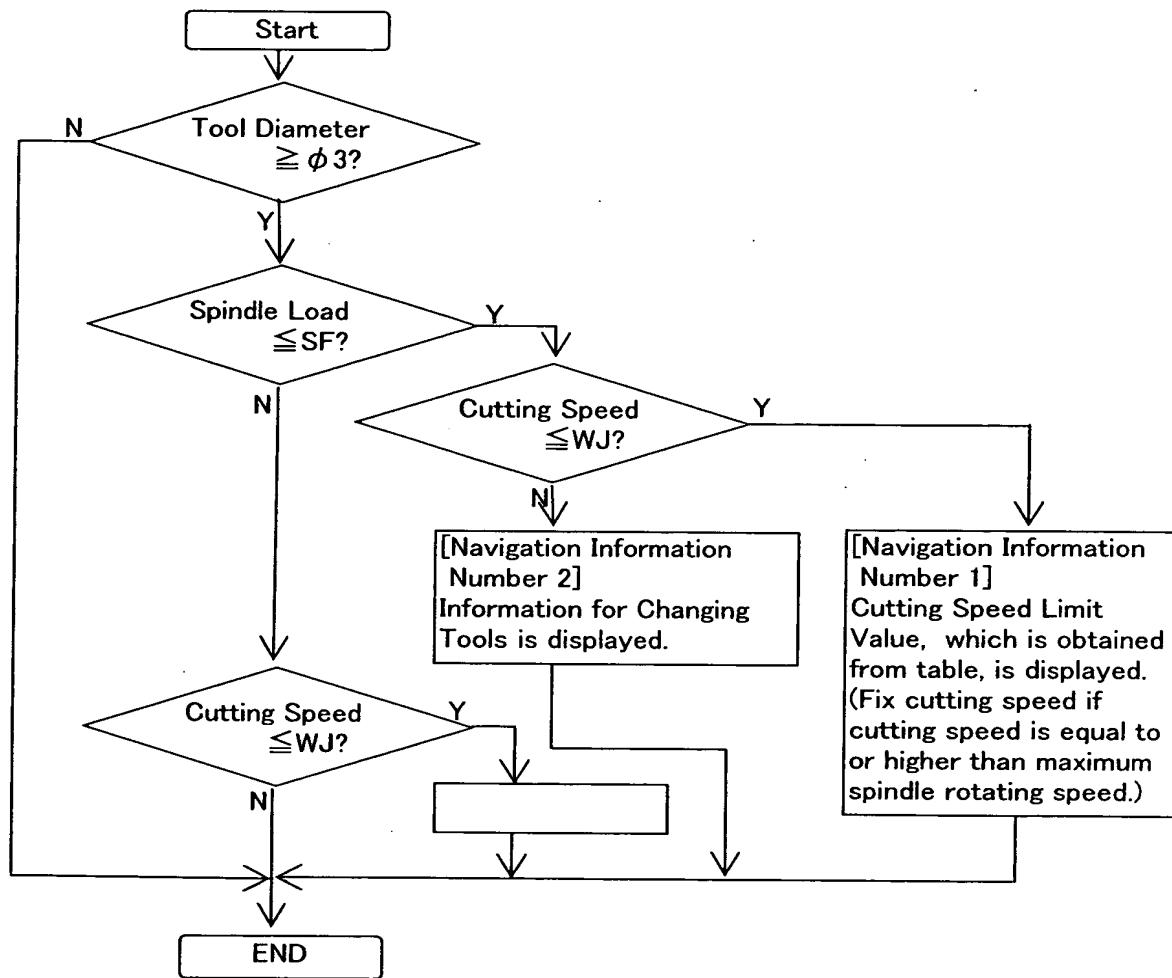
Spindle Load $\leq SF$ ?	Cutting Speed $\leq WJ$ ?	Spindle Rotating Speed $\leq CH$ ?	Processing
No	No	No	-
No	No	Yes	Navigation Information Number 6 is displayed. (Change cutting tool material.)
No	Yes	No	
No	Yes	Yes	Navigation Information Number 5 is displayed. (Increase cutting speed.)
Yes	No	No	
Yes	No	Yes	Navigation Information Number 7 is displayed. (Change tool diameter.)
Yes	Yes	No	Navigation Information Number 5 is displayed. (Increase cutting speed.)
Yes	Yes	Yes	Navigation Information Number 5 is displayed. (Increase cutting speed.)

October 8, 1997

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Navigation Information Number	Message
1	<ul style="list-style-type: none"> <li>· Increasing cutting speed to limit value is possible</li> </ul>
2	<ul style="list-style-type: none"> <li>· Change cutting tool material and increase cutting speed</li> <li>Change HSS tool (small diameter) to carbide tool</li> <li>Change HSS tool (large diameter) to throw away tool</li> <li>Change carbide tool to coolant through tool (for spindle through machines)</li> <li>Change carbide tool to carbide coating tool (for non-spindle through machines)</li> </ul>
3	<ul style="list-style-type: none"> <li>· Increase cutting speed to limit value</li> <li>(fix cutting speed if cutting speed is equal to ) (or higher than maximum spindle rotating speed )</li> </ul>
4	<ul style="list-style-type: none"> <li>· Change cutting tool material and increase cutting speed</li> <li>Change HSS tool (small diameter) to carbide tool</li> <li>Change HSS tool (large diameter) to throw away tool</li> </ul>
5	<ul style="list-style-type: none"> <li>· Increasing cutting speed to limit value is possible</li> <li>(fix cutting speed if cutting speed is equal to ) (or higher than maximum spindle rotating speed )</li> </ul>
6	<ul style="list-style-type: none"> <li>· Change cutting tool material and increase cutting speed</li> <li>Change carbide tool to carbide coating tool (except when the workpiece material is AL)</li> </ul>
7	<ul style="list-style-type: none"> <li>· Decrease tool diameter and increase rotating speed</li> </ul>
8	<ul style="list-style-type: none"> <li>· Increasing cutting speed to limit value is possible</li> <li>(fix cutting speed if cutting speed is equal to ) (or higher than maximum spindle rotating speed )</li> </ul>
9	<ul style="list-style-type: none"> <li>· Change to tool with a larger teeth number and increase feed rate</li> <li>· Change cutting tool material and increase cutting speed</li> <li>· Change HSS tool to carbide tool</li> <li>Change carbide tool to carbide coating tool (except when the workpiece material is AL)</li> </ul>
10	<ul style="list-style-type: none"> <li>· Change to tool with a larger teeth number and increase feed rate</li> <li>· Change cutting tool material and increase cutting speed (except when workpiece material is AL)</li> <li>Change carbide tool to carbide coating tool or cermet tool</li> <li>Change carbide coating tool to cermet tool</li> </ul>
*) The above may change depending on conditions of workpiece clamping and cutting tools. Life of tools may be shortened.	

October 8, 1997

YAMAZAKI MAZAK KABUSHIKI KAISHA  
Machining Technology Research Center**Machining Navigation: Navigating Function Flow Chart****Drilling Machining**

1) Spindle Load Limit Value Parameter...80% (default: 80%)

2) Drilling Machining Cutting Speed Limit Value Table

Cutting speed limit value is calculated in accordance with the rules for automatically determining cutting conditions.

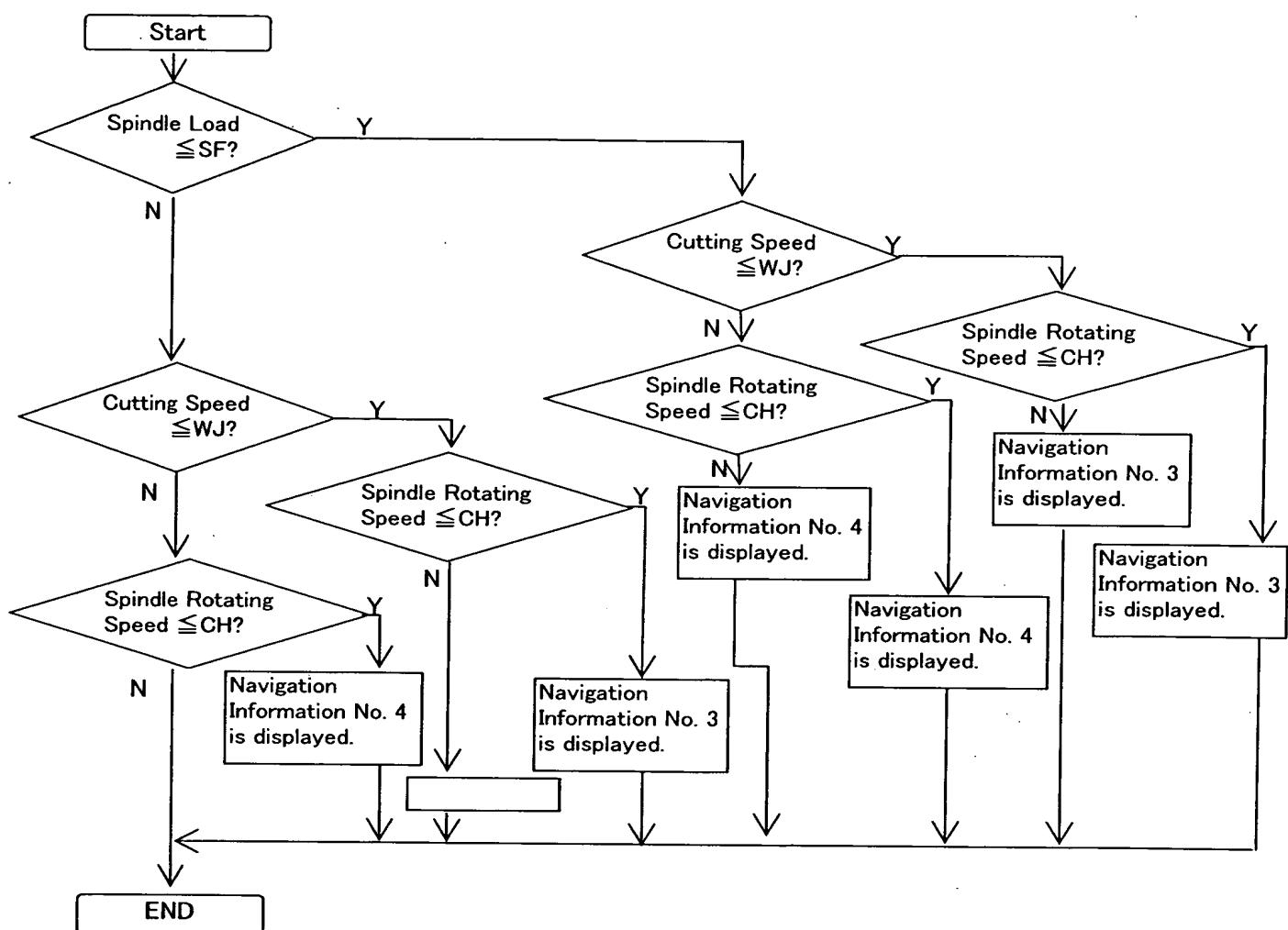
Workpiece Material	Basic Cutting Speed Limit Value
FC	29
FCD	26
S45C	29
SCM	23
SUS	14
AL	75
CU	75
...	

m/min

Tool Material	Compensation Coefficient
HSS	100
Carbide	220
HSS Coating	145
Coolant Through	460
Throw Away	560
Brazed	240

%

October 8, 1997

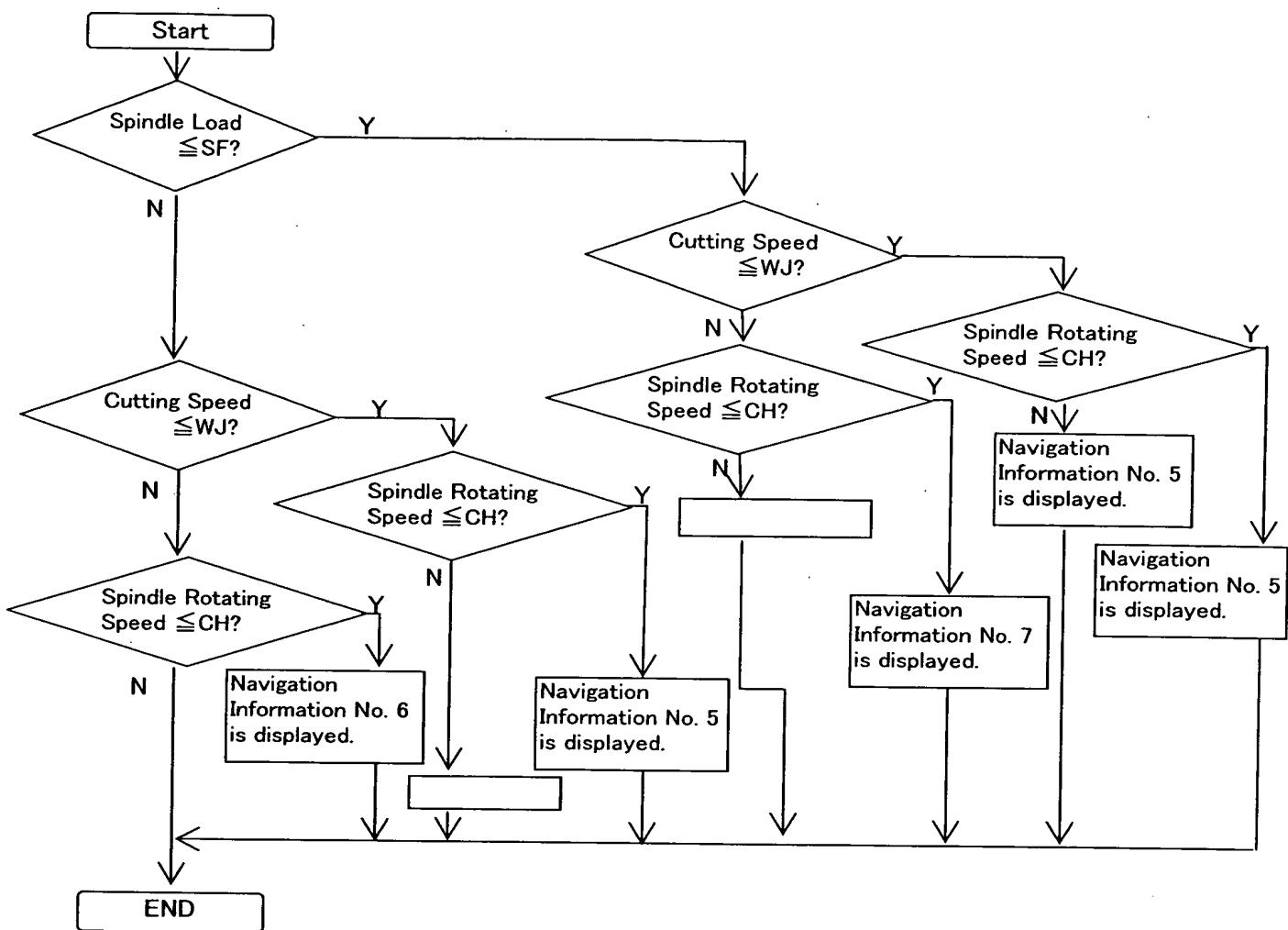
YAMAZAKI MAZAK KABUSHIKI KAISHA  
Machining Technology Research Center**End Mill (Roughing) Machining****3) End Mill Machining Cutting Speed Limit Value Table**

Cutting speed limit value is calculated in accordance with the rules for automatically determining cutting conditions.

	Basic Cutting Speed Limit Value
FC	124
FCD	104
S45C	98
SCM	92
SUS	86
AL	690
CU	230
...	

	Compensation Coefficient
HSS	27
Carbide	100
HSS Coating	32
Carbide Coating	112
Roughing	38
Throw Away	150
...	

October 8, 1997

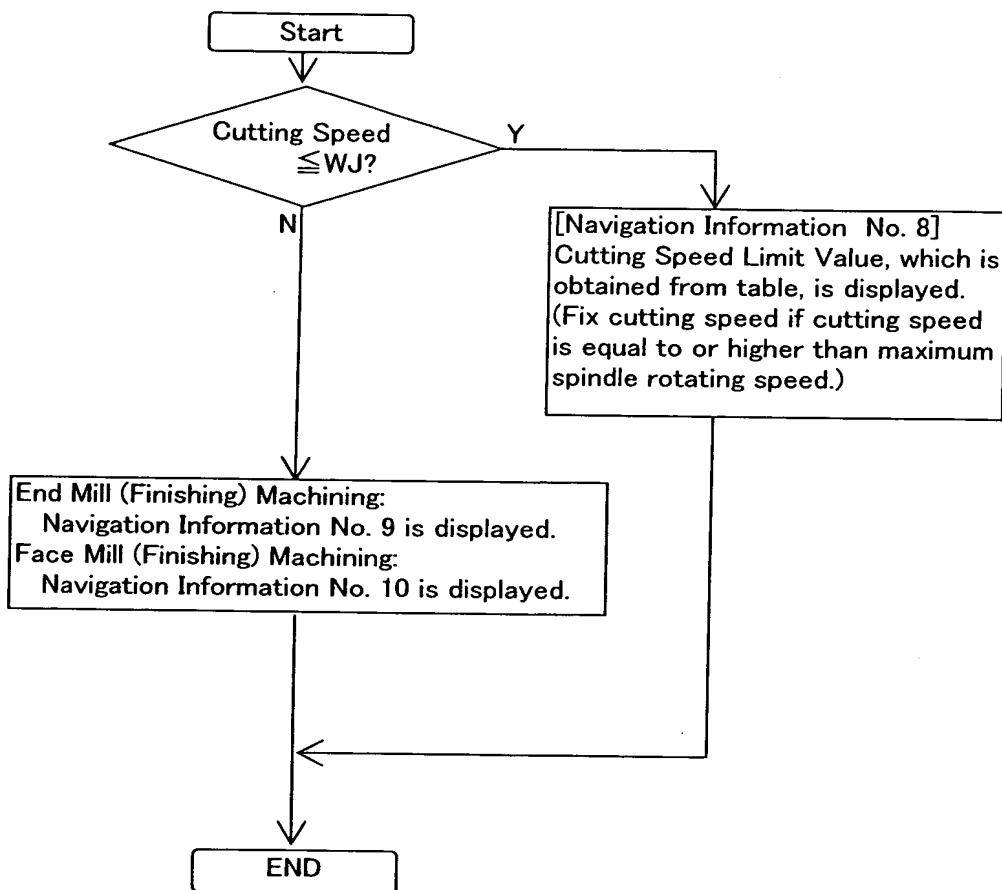
YAMAZAKI MAZAK KABUSHIKI KAISHA  
Machining Technology Research Center**Face Mill (Roughing) Machining****3) Face Mill Machining Cutting Speed Limit Value Table**

Cutting speed limit value is calculated in accordance with the rules for automatically determining cutting conditions.

	Basic Cutting Speed Limit Value
FC	138
FCD	124
S45C	184
SCM	138
SUS	184
AL	990
CU	300
...	

	Compensation Coefficient
Carbide	100
Cermet	120
Carbide Coating	115
...	

October 8, 1997

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Machining Technology Research Center**End Mill (Finishing) Machining, Face Mill (Finishing) Machining and Drilling Machining****4) Drilling Machining    Cutting Speed Limit Value Table**

Cutting speed limit value is calculated in accordance with the rules for automatically determining cutting conditions.

	Basic Cutting Speed Limit Value
FC	69
FCD	80
S45C	109
SCM	92
SUS	288
AL	143
CU	
...	

	Compensation Coefficient
HSS	55
Carbide	100
Cermet	100
Balanced Cut	120
...	